WAVE HEIGHT AND WAVE ENERGY MAPPING IN MALAYSIAN SEAS USING SATELLITE ALTIMETRY DATA

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DEDICATION

I dedicate this work to my beloved Mother, Father, Sisters, Brother, Ayah Cik, and All My Best Friends

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ABSTRACT

In recent development of water base renewable energy, Malaysia is one of country which are active on this matter. In order to assess an area for wave energy mapping and development, the wave climate or seasonal wave mapping must be defined. Acquiring an accurate and reliable wave climate data is one of the crucial step in the assessment of wave energy resources. Using satellite altimeter have resolve two main problems with conventional wave measurements, which are spatial distribution of data and the accuracy for wave height data. Using altimeter technology, wave period are derive and the estimation of wave power in Malaysian seas can be accurately estimate. The Radar Altimeter Database System located at Global Navigation Satellite System and Geodynamics Laboratory Universiti Teknologi Malaysia, was used to extract the significant wave height and wind speed data. Validation was carried out for wave height and wave period using in-situ measurement. According to validation results, altimeter derived data is closely consistent with buoy data and correlation coefficient for European Remote Sensing Satellite 2 and Envisat are 0.9587 and 0.982 respectively for wave height and 0.750 respectively for wave period from Envisat. The monthly averages of altimetry significant wave height and wave energy starting from January 1993 to December 2011 were mapped in this study. The results shows Northeast Monsoon clearly have the most significant effect on Malaysian seas. The Southwest monsoon have very minimal effect on Malaysian seas. Average wave height during Northeast Monsoon were around 1.5m to 2.2m for the open seas and 0.6m to 0.8m for closed sea area. The results also shows that during Southwest monsoon most of Malaysian seas only have less than 1m of wave height except on certain places near the coast of Borneo. The average of wave power during Northeast Monsoon were round 8kW/m to 15kW/m for open seas and less than 5kW/m for sheltered sea area.

ABSTRAK

Perkembangan terbaru dalam bidang tenaga boleh diperbaharui berasaskan air, Malaysia adalah salah satu negara yang aktif dalam hal ini. Untuk menilai dan memetakan tenaga ombak, iklim ombak atau pemetaan ombak bermusim perlu dibuat. Memperolehi data iklim ombak yang tepat dan boleh dipercayai adalah langkah yang penting dalam penilaian sumber tenaga ombak. Satelit altimeter telah menyelesaikan dua masalah utama ukuran ombak konvensional, iaitu masalah taburan data spatial dan ketepatan data ketinggian ombak. Dengan teknologi altimeter, tempoh ombak diterbitkan dan anggaran kuasa ombak di laut Malaysia boleh dibuat dengan tepat. Sistem Pangkalan data Radar Altimeter di Makmal Sistem Navigasi Satelit dan Geodinamik Universiti Teknologi Malaysia, telah digunakan untuk menyari data ketinggian ombak dan kelajuan angin yang ketara. Pengesahan data dilakukan dengan menggunakan pengukuran secara terus. Merujuk keputusan pengesahan, data terbitan altimeter hampir konsisten dengan data boya dan nilai pekali korelasi untuk Satelit Penderiaan Jauh Eropah 2 dan Envisat, masing-masing adalah 0.9587 dan 0.982 untuk ketinggian ombak dan 0.750 bagi tempoh ombak Envisat. Purata ketinggian ombak dan tenaga ombak yang ketara dari altimeter bermula dari Januari 1993 hingga Disember 2011 telah dipetakan. Monsun Timur Laut dengan jelas mempunyai kesan yang paling ketara, tidak seperti Monsun Barat Daya yang mempunyai kesan yang sangat minimum ke atas laut Malaysia. Ketinggian purata ombak pada Monsun Timur Laut diantara 1.5m sehingga 2.2m untuk laut terbuka dan 0.6m sehingga 0.8m bagi laut tertutup. Sementara itu pada Monsun Barat Daya, laut Malaysia hanya mempunyai ketinggian ombak kurang daripada 1m kecuali pada tempat-tempat tertentu berhampiran pantai Borneo. Purata kuasa ombak pada tempoh Monsun Barat Daya adalah dalam lingkungan 8kW/m ke 15kW/m bagi laut terbuka manakala kurang daripada 5kW/m bagi kawasan laut terlindung.